RESEARCH HIGHLIGHT

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Straw Bale Construction in Atlantic Canada

This report summarizes profiles of 34 straw bale buildings constructed in Atlantic Canada between 1993 and 2006. It focuses on best practices, remediation strategies and project highlights. Profiles are based on information gathered through surveys, personal interviews, and site visits.

In addition to the profiles, a regional map locating the various projects, an audio-video collection of interviews with many of the participants and a searchable database were created. It is hoped the database will continue to evolve as an interactive resource tool for capturing information on future builds.

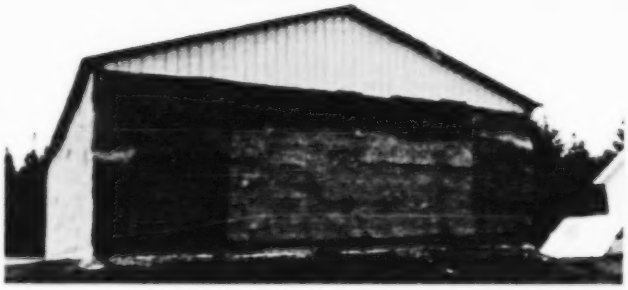
PROJECT CONTEXT

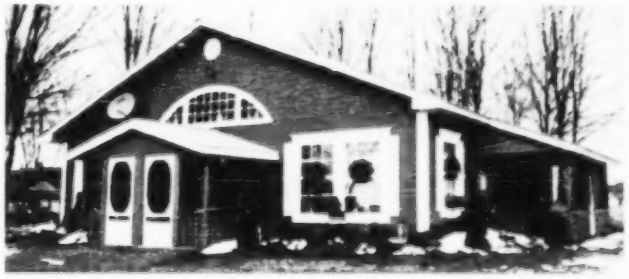
The first straw bale building in Atlantic Canada was constructed in 1993 in Ship Harbour, N.S. Over the next 13 years another 54 straw bale buildings, including large and small homes, sheds, studios, garages, a youth centre and barns, were built in the region.

While the earliest straw bale buildings are found in Nova Scotia, in recent years there has been a notable increase in the number of starts, and general interest in straw bale construction, in both Prince Edward Island and New Brunswick. As of 2006, no straw bale buildings had been identified in Newfoundland and Labrador. All of the buildings profiled are in rural settings, though not necessarily remote; three are in residential developments near small towns.

Weather in Atlantic Canada varies considerably, depending on elevations and proximity to the ocean. Intense freeze-thaw cycles generate demanding building conditions, as do frequent winds that bring driving, horizontal rain. Mean daily temperatures range from -7°C (19°F) in the winter, to 20° C (68°F) in the summer. Annual precipitation varies from province to province, averaging around 152 cm (60 in.).

The methods for using straw bales in building systems in Atlantic Canada vary according to individual budgets, site-specific characteristics (particularly in relation to the climatic conditions of the region) and the experience of each of the builders. While bales were primarily used in wall systems, there are also examples of foundation, floor and roof applications. Seven of the buildings described in the report have load-bearing straw bale walls.





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HOME TO CANADIANS

RELEVANT FINDINGS

In addition to creating a database to describe a variety of straw bale buildings, the study also captured comments and reflections that research participants saw as useful ways of improving systems and designs for future straw bale projects. The following points highlight some of these best practices.

Bales

- Use tight, dry, high-quality bales with evenly tensioned strings.
- Know your farmer. Be sure the farmer is aware, at the time of baling, what the bales are intended for.
- Pre-order building bales to ensure they will be available at the time of installation.
- Shelter bales appropriately to ensure they are protected from rain, and that they are off the ground. Have lots of extra tarps on hand.

Design

- Keep up-to-date on best practices and consult designers who have worked with straw bales before.
- Pay close attention to the site's relationship to the sun, wind, topography and local weather patterns.
- Simple designs work well with bale construction, especially with an inexperienced building crew.
- Hold off installing bales on non-load-bearing walls until the roofs are complete.
- For larger projects, unless they are very well-orchestrated, infill systems work best in the rainy maritime climate.
- Introduce heat sinks–thermal mass wherever possible to maximize solar gain.
- Take into account bale dimensions when sizing a building: that is, refer to it as seven bales high on the main floor and 15 bales long.
- Consider the functional intention of a space and then be creative! How multi-functional can it become?
- Use combinations of systems to most effectively respond to site-specific challenges: for example, earth plasters with wood cladding, or earth sheltered and straw bale.
- Wool is an under-used resource in Atlantic Canada, and it can successfully complement straw bales for building insulation.

Foundation

- Bales should always sit on a curb to isolate them from possible flooding.
- Placing bales below grade is not recommended.
- Build the foundation 30–45 cm (12–17 in.) above grade, according to the site demands.
- Use foundations and floors as an opportunity for thermal massing.

Straw Bale Walls

- Maintain the integrity of the exterior of bale walls with as few transitions of material as possible.
- Wood siding in combination with earth plaster is recommended for facades which receive wind-driven rains.
- Excellent attention to stuffing is essential for good straw bale wall construction.

Windows

- Effective drip edges are essential for all windows.
- Flashing details are extremely important to get right. Wide flashing on all four sides of openings that are not well protected is highly recommended.
- Decreasing overhangs on sides of the house that get less weather will allow more light into the house. Sky lights, solar tubes and clear overhangs are other ways to bring more light in.

Finishes

- Don't begin plastering if there is not adequate drying time before the first frost.
- Make many tests before applying plaster to the bales.
- Protect exposed earth plasters with tarps while drying.
- Tarp clay soil when not in use.
- Reinforce transition areas and corners with mesh, such as metal, fibreglass, plastic or burlap.
- Clay-rich earth combined with wheat or milk binders works well for interior plasters.
- Potassium silicate paint will stabilize clay or lime renders and paints that are prone to dusting or are crumbly.
- Lime splashes on wood leaves permanent marks.

Roof

- Construction of the roof before wall raising is strongly recommended in Atlantic Canada in order to protect the bales during construction.
- Good overhangs are essential—they provide sun protection in summer, and rain, snow and wind protection throughout the year.
- Install gutters early in the building process to protect freshly plastered walls from rain splashback.

Labour and Organization

- Work closely with tradespeople as the logistics of building with bales is different than what they are accustomed to. Ask questions!!
- Using experienced tradespeople to train volunteers is an efficient way to complete a job and ensure good quality work.
- Be patient with inspectors, insurers and financers. Be prepared to educate them by sharing your books, videos and photos. There is a list of insurers and lenders familiar with straw bale construction in the main report.
- Whenever possible, use local resources for supplies and services.
- The importance of keeping an eye on quality control is essential.
- Building a small structure allows novice builders to become familiar with the materials before launching a larger project.
- Understanding timelines is important to understanding the total costs involved when building a home.
- Be vigilant on building sites to clean up loose straw and ensure that there are no potential fire hazards. Keep water hoses and fire extinguishers nearby and working.
- Have fun!

The table below presents some of the problems that the builders surveyed encountered and their solutions to the problems.

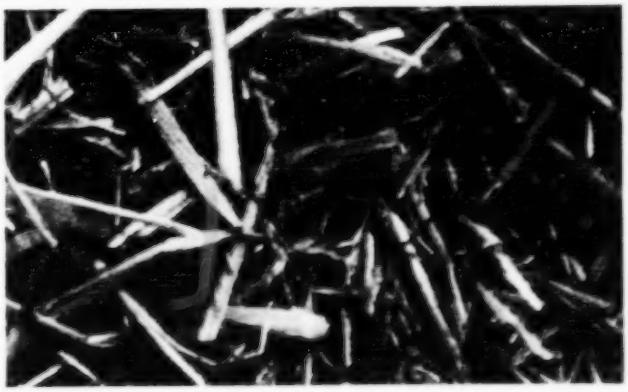
In summary, bale builders have employed many creative remediation strategies over the years. It has been gratifying to see how simply and successfully these strategies can be applied, but it can not be overstated that the success of a building (any building) lies largely in the efficacy of the detailing.

IMPLICATIONS FOR BUILDERS AND HOMEOWNERS

This study explores some of the common themes, issues and design features straw bale construction has encountered in the Atlantic Provinces. Many new projects are on the horizon and these are expected to continue to nudge our understanding of how to best integrate appropriate technology and natural building systems in order to create the most energy efficient buildings possible for the region.

This report is a good resource for homeowners, educational institutions, contractors and government from which to appreciate the viability of straw bale construction for northerly maritime climates.

Problem	Solution
Wind-driven rain and exposure	Installing wood rainscreens and improved flashing
Inadequate overhang, resulting in deterioration of plasters	Lime plaster over the earthen coat, construction of rain screens and a roof extension
Ice damming and missing gutters causing water damage to earthen plasters	Ensure proper installation of the roof and roof detailing
Poor drainage around the slab	Add weeping tile and regrade the land to slope away from the building
Poor window detailing, resulting in water penetration	Replace wet bales, add wider flashing around windows
Soft bales causing differential settling of the roof on load-bearing building	Lifting the roof, setting in a wood frame and tying the bales back to the frame
Cracks in cement, lime and earth plasters	Avoid wood and metal detail interruptions. Repair with silicon caulks or natural caulks, such as lime and earth.
Fire	Loose straw during the build and pre-plaster can be a hazard; be aware and extra cautious at such times
Crumbly plaster	Test plasters as soil composition can vary from site to site. Crumbly surfaces generally need to be removed and reconfigured with different proportions.
Unfinished plastering before freeze-up	Move mixing stations indoors, then tarp and heat the space till dry; or tarp walls and finish in spring; or consider use of wood siding instead of finish plaster
Rodents	Detail possible ingress points as you would regular constructions; employ a cat; or both



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